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Document Title **LAT Calorimeter AFEE Circuit Card Assembly Test Mating Procedure**		

Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT) Calorimeter

AFEE Circuit Card Assembly Test Mating Procedure

MASTER DOCUMENT
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GLAST-CAL CM FILE COPY

DOCUMENT APPROVAL

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
	1/13/03	Initial Release of LAT-PS-01335, Engineering Model AFEE Board Test Procedure
01	6/04/04	Document revised for flight AFEE Board and use of AFEE Monitor and Breakout Board.

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1 INTRODUCTION

1.1 PURPOSE

This document details the procedures for performing initial test of connections between the Tower Electronics Modules (TEMs) and the AFEE Circuit Card assemblies prior to board level testing. The Cal AFEE Board Verification Plan is to be followered after this procedure.

1.2 APPLICABLE DOCUMENTS

The following documents are applicable to the extent specified within. Unless otherwise indicated, the latest issue in effect shall apply. In the event of a conflict between these documents and the contents of LAT-SS-01335, those contained herein shall be considered the superseding requirement.

NASA-STD-8739.7	Electrostatic Discharge Control
LAT-MD-00408	LAT Program Instrument Performance Verification Plan
LAT-SS-00210	LAT-CAL Subsystem Level IV Specification
LAT-SS-00222	Calorimeter Module Assembly, Test, and Calibration Requirements
LAT-SS-00262	Calorimeter Module Assembly and Test Plan
LAT-SS-01345	Calorimeter Module Verification & Environmental Test Plan
LAT-SS-01371	Calorimeter Module Functional Test Procedure
LAT-DS-03761	Cal AFEE Monitor and Breakout Board Layout
LAT-DS-03760	Cal AFEE Monitor and Breakout Board Schematic
LAT-DS-03346	Cal AFEE-X Circuit Card Assembly Drawings
LAT-DS-03347	Cal AFEE-Y Circuit Card Assembly Drawings
LAT-SS-03601	Cal AFEE Board Verification Plan

1.3 DEFINITIONS AND ACRONYMS

1.3.1 Acronyms

AFEE	Analog Front End Electronics of the Calorimeter
CAL	Calorimeter Subsystem of the LAT
CCA	Circuit Card Assembly
CDE	Crystal Detector Element of the PEM
DAS	Data Acquisition System
ESD	Electrostatic Discharge
GCFE	Glast Calorimeter Front-end Electronics
GCRC	Glast Calorimeter Readout Control electronics
GLAST	Gamma-Ray Large Area Space Telescope
LAT	Large Area Telescope
PEM	Pre-Electronics Module of the CAL
TEM	Tower Electronics Module

2 ANALOG FRONT END ELECTROINCS CONNECTIONS DESCRIPTION

The Calorimeter Analog Front End Electroincs (AFEE) boards are the flight electronics which convert the CDE PIN diode electrical signals to digital bits, which are then sent to the Tower Electronics Module (TEM). There is one AFEE board per side of the cubic shaped Calorimeter. Each Calorimeter module consists of two AFEE-X boards and two AFEE-Y boards. A "Y" shaped cable from two 37 contact Nano connectors joined to one 69 contact micro connector is part of the assembly. The electrical interface between the TEM and the Calorimeter is at the 69 contact micro connector.

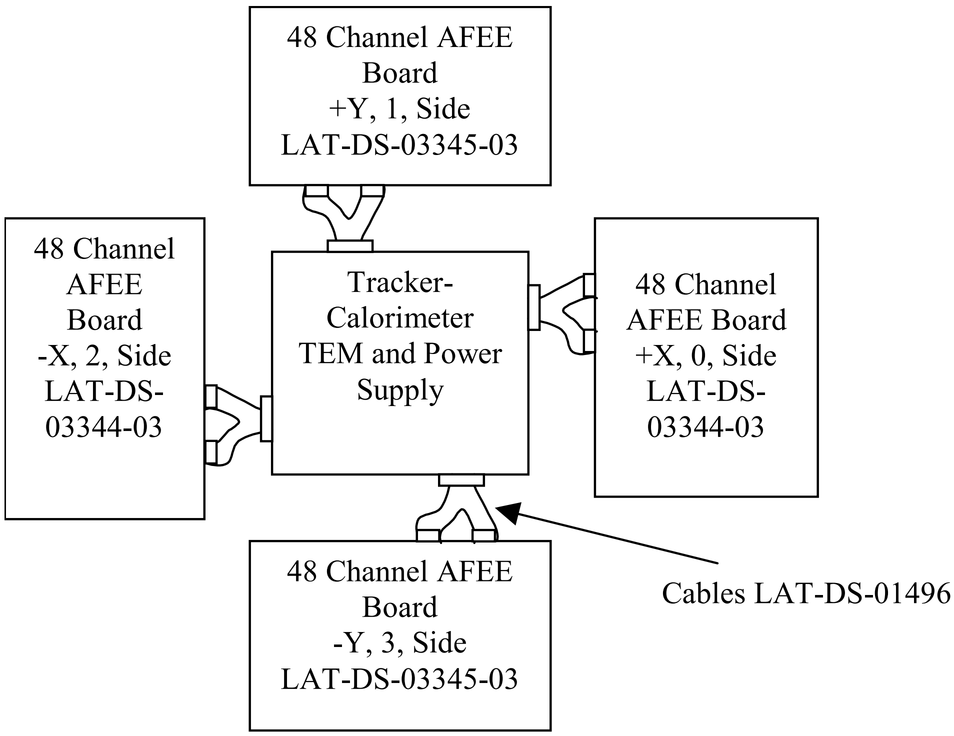


Figure 1 – AFEE to TEM Flight Configuration and Connections.

3 AFEE MONITOR AND BREAKOUT BOX CONNECTION CONFIGURATION

The AFEE Montior and Breakout Box, referred to as simply the AFEE Monitor board, is used as an interface between a TEM and four AFEE boards in test configuration of the AFEE boards. The AFEE Monitor board will not be used as an interface once the AFEE boards are mounted on the flight calorimeter structure.

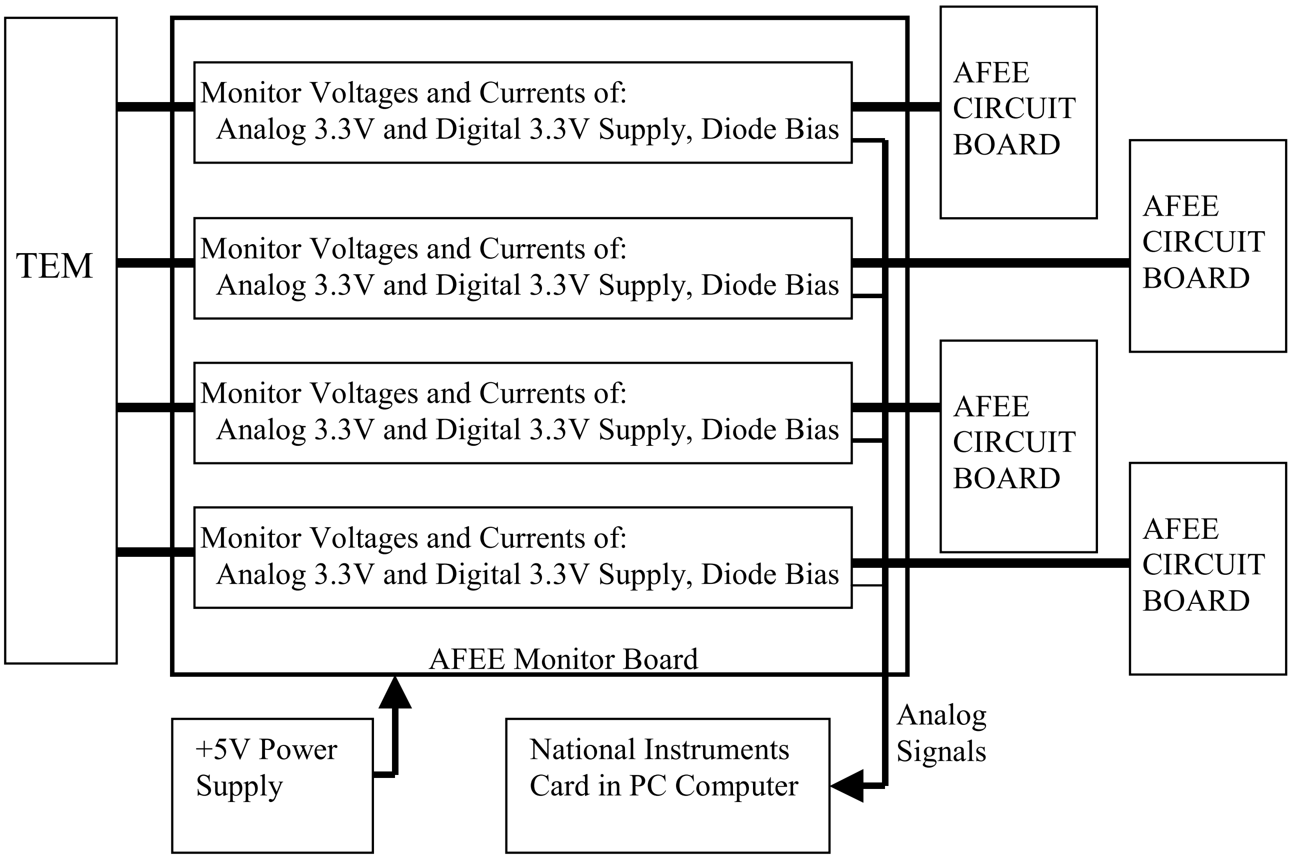


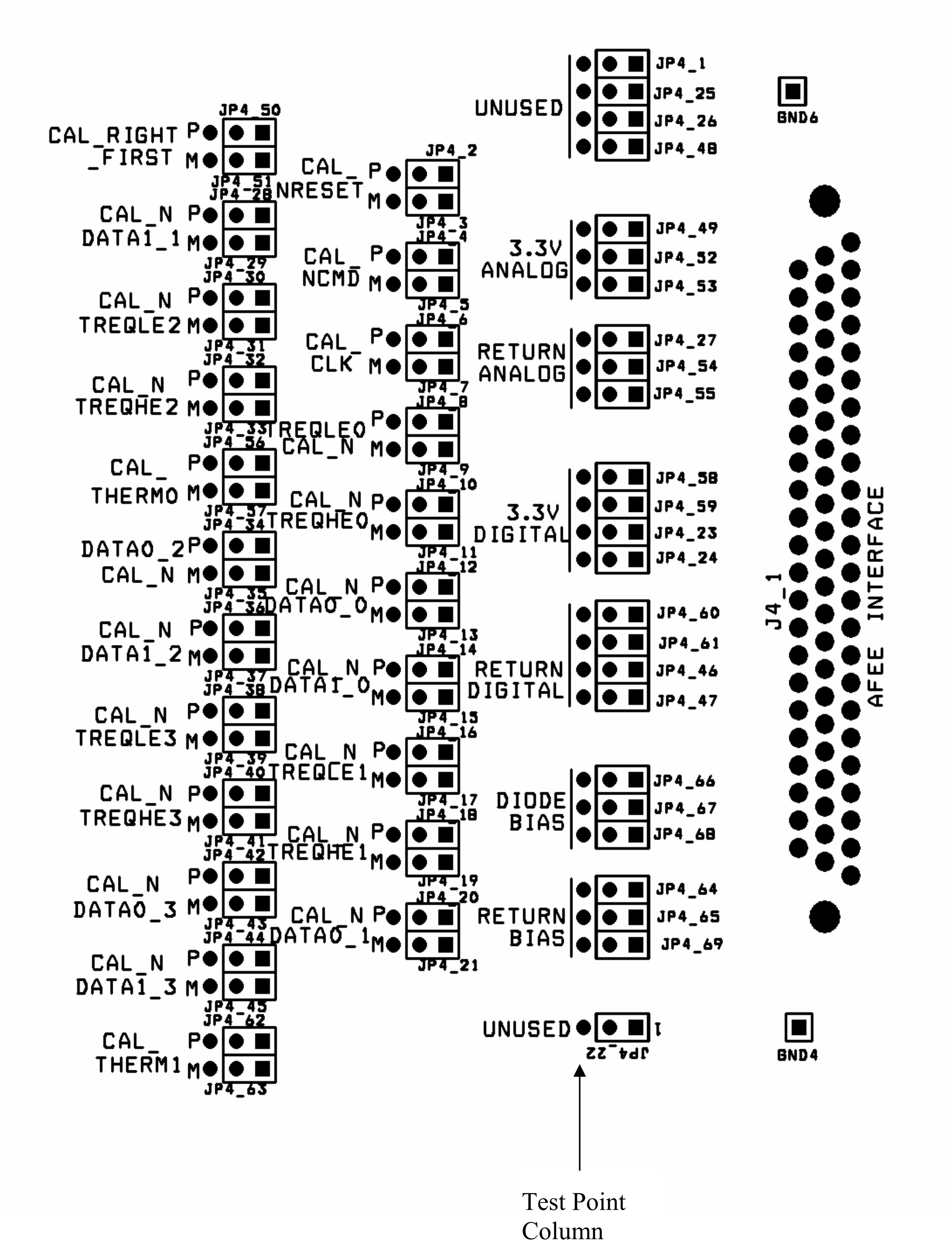
Figure 2 – AFEE Monitor Board Connection Diagram

The AFEE Montior Board enables monitoring of each AFEE Board supply voltage and currents. The voltages and currents are periodically logged by the connected PC computer.

The AFEE Monitor board has jumpers and Test Points for each signal and supply voltage line connection to the TEM. Same net power lines are connected together after the jumper. The test point are on the AFEE side of the jumper, thus if a jumper is removed the test point measures the disconnected AFEE board side of the line.

The power supply retuns from all the TEM connectors are effectivly connected together and to the AFEE Monitor power supply ground. This is needed to accuratly report the voltages and currents from each AFEE board.

Figure 3. AFEE Monitor Board Jumpers and Test Points for one AFEE-TEM Connector.



4 AFEE CONNECTION TEST DESCRIPTION

4.1 AFEE Receiving Inspection Procedure:

Visually inspect AFEE circuit board under magnification for bad or missing solder joints. Inspect fine-pitch parts for solder bridging. Boards must pass visual inspection to proceed.

TEMs used for testing AFEE boards must have previously been checked out and passed the TEM Mating and Verification Procedure.

Prior to running functional tests on any received flight AFEE boards, AFEE connections must first be tested as follows:

1) Check AFEE Connections un-powered
2) Check AFEE Connections Powered.

4.2 Unpowered AFEE Connections Checkout

Procedure:

1) Make sufficient copies of Table 1 and Table 2, one copy for each AFEE board to be tested. Write AFEE board serial numbers to be tested on the sheets along with the date.
2) Make sure that TEM is not powered and make sure that the AFEE Monitor Box cabling is not connected to the TEM.
3) Reconnect any AFEE Monitor board jumpers removed from possible previous TEM testing.
4) Attach AFEE board to AFEE Monitor box through 69 contact Micro-D connector cables, which are part of the AFEE Monitor box.

With calibrated hand-held ohmmeter, probe AFEE Supply and Returns for proper continuity (Table 1) and record.

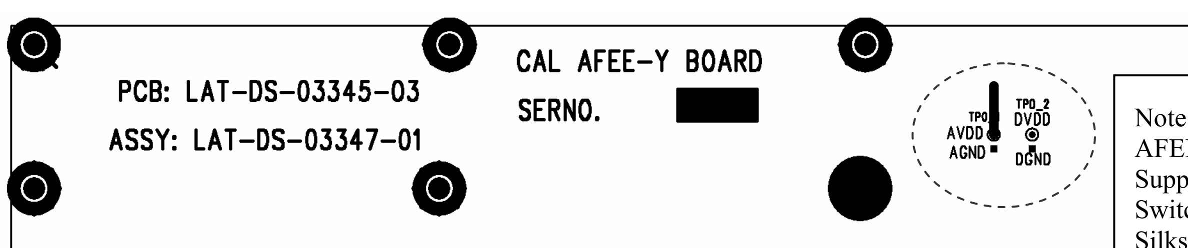
5) Figure 4 and Figure 5 show power supply testpoint locations on both the AFEE-X and AFEE-Y circuit cards. Note that AFEE-Y board has reversed sikscreen text for supply and ground test points. The supply testpoint is marked ground, and the ground testpoint is marked supply (VDD).
6) With ohmmeter, probe AFEE board signal lines in the AFEE Monitor box as directed in Table 2 and record measurements

Table 1. AFEE Unpowered Impedance Measurements.

AFEE Card Assembly Serial Number:					**Date:**	
	Monitor Board 3.3V Analog		**Monitor Board 3.3V Digital**		**Monitor Board Bias Voltage**	
	Measured Impedance	Expected	Measured Impedance	Expected	Measured Impedance	Expected
Monitor Board 3.3V Analog	*Not Measured*			> 1k ohm < 5k ohm		> 1 M ohm
Monitor Board 3.3V Digital		> 1k ohm < 5k ohm	*Not Measured*			> 1 M ohm
Monitor Board Returns		> 0.4k ohm < 2k ohm		> 1k ohm < 3k ohm		> 1 M ohm
Cal_Right_First Return M		> 0.4k ohm < 2k ohm		> 1k ohm < 3k ohm		> 1 M ohm
AFEE Board Analog 3.3V Testpoint		< 1.0 ohm	*Not Measured*		*Not Measured*	
AFEE Board Digital 3.3V Testpoint	*Not Measured*			< 1.0 ohm	*Not Measured*	
	Monitor Board 3.3V Return Analog		**Monitor Board 3.3V Return Digital**			
AFEE Board Analog Gnd Testpoint		< 1.0 ohm	*Not Measured*		*Not Measured*	
AFEE Board Digital Gnd Testpoint	*Not Measured*			< 1.0 ohm	*Not Measured*	

Figure 4. Analog 3.3V and Digital 3.3V Testpoints on bottom edge of flight AFEE-X Board. Testpoints circled.

Figure 5. Analog 3.3V and Digital 3.3V Testpoints on top edge of flight AFEE-Y Board. Testpoints circled.



Note:
AFEE-Y Board Supply Silkscreens Switched with Gnd Silkscreens.

Table 2. AFEE Unpowered Impedance Measurements, High Impedance-to-Ground Signals. All impedances expected to be greater than 1 Meg ohm.

AFEE Card Assembly Serial Number:		**Date:**	
No.	**Signal Probed on AFEE Monitor Board**	**Measured Resistance to AFEE Chassis Gnd**	**Expected Resistance Value**
2	CAL_NRESETP		2 Meg ohm < Meas < 9 Meg ohm
3	CAL_NRESETM		2 Meg ohm < Meas < 9 Meg ohm
4	CAL_NCMDP		2 Meg ohm < Meas < 9 Meg ohm
5	CAL_NCMDM		2 Meg ohm < Meas < 9 Meg ohm
6	CAL_CLKP		2 Meg ohm < Meas < 9 Meg ohm
7	CAL_CLKM		2 Meg ohm < Meas < 9 Meg ohm
8	CAL_NTREQLE0P		2 Meg ohm < Meas < 9 Meg ohm
9	CAL_NTREQLE0M		2 Meg ohm < Meas < 9 Meg ohm
10	CAL_NTREQHE0P		2 Meg ohm < Meas < 9 Meg ohm
11	CAL_NTREQHE0M		2 Meg ohm < Meas < 9 Meg ohm
12	CAL_NDATA0_0P		2 Meg ohm < Meas < 9 Meg ohm
13	CAL_NDATA0_0M		2 Meg ohm < Meas < 9 Meg ohm
14	CAL_NDATA1_0P		2 Meg ohm < Meas < 9 Meg ohm
15	CAL_NDATA1_0M		2 Meg ohm < Meas < 9 Meg ohm
16	CAL_NTREQLE1P		2 Meg ohm < Meas < 9 Meg ohm
17	CAL_NTREQLE1M		2 Meg ohm < Meas < 9 Meg ohm
18	CAL_NTREQHE1P		2 Meg ohm < Meas < 9 Meg ohm
19	CAL_NTREQHE1M		2 Meg ohm < Meas < 9 Meg ohm
20	CAL_NDATA0_1P		2 Meg ohm < Meas < 9 Meg ohm
21	CAL_NDATA0_1M		2 Meg ohm < Meas < 9 Meg ohm
50	CAL_RIGHT_FIRST P		2 Meg ohm < Meas < 9 Meg ohm
28	CAL_NDATA1_1P		2 Meg ohm < Meas < 9 Meg ohm
29	CAL_NDATA1_1M		2 Meg ohm < Meas < 9 Meg ohm
30	CAL_NTREQLE2P		2 Meg ohm < Meas < 9 Meg ohm

AFEE Card Assembly Serial Number:		**Date:**	
No.	**Signal Probed on AFEE Monitor Board**	**Measured Resistance to AFEE Chassis Gnd**	**Expected Resistance Value**
31	CAL_NTREQLE2M		2 Meg ohm < Meas < 9 Meg ohm
32	CAL_NTREQHE2P		2 Meg ohm < Meas < 9 Meg ohm
33	CAL_NTREQHE2M		2 Meg ohm < Meas < 9 Meg ohm
56	CAL_THERM0P		Meas > 9 Meg ohm
57	CAL_THERM0M		Meas > 9 Meg ohm
34	CAL_NDATA0_2P		2 Meg ohm < Meas < 9 Meg ohm
35	CAL_NDATA0_2M		2 Meg ohm < Meas < 9 Meg ohm
36	CAL_NDATA1_2P		2 Meg ohm < Meas < 9 Meg ohm
37	CAL_NDATA1_2M		2 Meg ohm < Meas < 9 Meg ohm
38	CAL_NTREQLE3P		2 Meg ohm < Meas < 9 Meg ohm
39	CAL_NTREQLE3M		2 Meg ohm < Meas < 9 Meg ohm
40	CAL_NTREQHE3P		2 Meg ohm < Meas < 9 Meg ohm
41	CAL_NTREQHE3M		2 Meg ohm < Meas < 9 Meg ohm
42	CAL_NDATA0_3P		2 Meg ohm < Meas < 9 Meg ohm
43	CAL_NDATA0_3M		2 Meg ohm < Meas < 9 Meg ohm
44	CAL_NDATA1_3P		2 Meg ohm < Meas < 9 Meg ohm
45	CAL_NDATA1_3M		2 Meg ohm < Meas < 9 Meg ohm
62	CAL_THERM1P		Meas > 9 Meg ohm
63	CAL_THERM1M		Meas > 9 Meg ohm

4.3 Powered AFEE Connections Checkout

Procedure:

Make sufficient copies of

Table 3 and

1) Table 4, one each per AFEE board to be tested. Write AFEE board serial number to be tested and date on sheets.
2) Make sure TEM is not powered.
3) Connect quantity four AFEE Monitor Box cables to the TEM. Cables are part of the AFEE Monitor box.
4) Reconnect any AFEE Monitor Board jumpers removed from possible previous TEM connection testing.
5) Attach AFEE board to AFEE Monitor box through 69 contact Micro-D connector cables. Cables are part of the AFEE Monitor box.
6) Power up TEM. Power up AFEE boards. Command TEM to Power AFEE bias Voltage to +75 Volts.
7) With calibrated hand-held voltmeter, record voltages to the AFEE board as directed in Table 3. Voltages measured between the noted voltage supply and the corresponding return, on the AFEE Monitor Board.
8) Record AFEE Monitor box monitored currents displayed on PC computer.
9) With voltmeter, meaasure AFEE board signal voltages in the AFEE Monitor box as directed in Table 4 and record measurements
10) Store recorded data.
11) Power down AFEE board and disconnect cable to AFEE board. Place EMI connector cap on AFEE connector. Bag AFEE board in static-safe bag.

Table 3. AFEE Powered Voltage and Current Measurements.

AFEE Serial Number:		**Date:**
	Measured Voltage	**Expected Voltage**
3.3V Analog Measured on Monitor Board Between 3.3V Analog and Return Analog		3.1< V <3.4 volts
3.3V Digital Measured on Monitor Board Between 3.3V Digital and Return Digital.		3.1< V <3.4 volts
Bias Voltage Measured on Monitor Board Between Bias Voltage and Return Bias		68< V <80 volts
	Measured Current	**Expected Current**
Analog Supply current measured by Monitor board		0.05 < A < 0.9 Amp
Digital Supply current measured by Monitor board		0.20 < A < 0.260 Amp
Bias Supply current measured by Monitor board.		< 10 uA

Table 4. AFEE Powered Measurements, Signal Voltages.

AFEE Serial Number:		**Date:**	
No.	**Signal**	**Measured Voltage to AFEE Chassis Gnd**	**Expected Voltage to AFEE Chasis Gnd**
2	CAL_NRESETP		0.9 < V < 1.4 volts
3	CAL_NRESETM		0.9 < V < 1.4 volts
4	CAL_NCMDP		0.9 < V < 1.4 volts
5	CAL_NCMDM		0.9 < V < 1.4 volts
6	CAL_CLKP		0.9 < V < 1.4 volts
7	CAL_CLKM		0.9 < V < 1.4 volts
8	CAL_NTREQLE0P		0.9 < V < 1.4 volts
9	CAL_NTREQLE0M		0.9 < V < 1.4 volts
10	CAL_NTREQHE0P		0.9 < V < 1.4 volts
11	CAL_NTREQHE0M		0.9 < V < 1.4 volts
12	CAL_NDATA0_0P		0.9 < V < 1.4 volts
13	CAL_NDATA0_0M		0.9 < V < 1.4 volts
14	CAL_NDATA1_0P		0.9 < V < 1.4 volts
15	CAL_NDATA1_0M		0.9 < V < 1.4 volts
16	CAL_NTREQLE1P		0.9 < V < 1.4 volts
17	CAL_NTREQLE1M		0.9 < V < 1.4 volts
18	CAL_NTREQHE1P		0.9 < V < 1.4 volts
19	CAL_NTREQHE1M		0.9 < V < 1.4 volts
20	CAL_NDATA0_1P		0.9 < V < 1.4 volts
21	CAL_NDATA0_1M		0.9 < V < 1.4 volts
50	CAL_RIGHT_FIRST P		0 or 3.3 volts
28	CAL_NDATA1_1P		0.9 < V < 1.4 volts
29	CAL_NDATA1_1M		0.9 < V < 1.4 volts
30	CAL_NTREQLE2P		0.9 < V < 1.4 volts
31	CAL_NTREQLE2M		0.9 < V < 1.4 volts
32	CAL_NTREQHE2P		0.9 < V < 1.4 volts

AFEE Serial Number:		**Date:**	
No.	**Signal**	**Measured Voltage to AFEE Chassis Gnd**	**Expected Voltage to AFEE Chasis Gnd**
33	CAL_NTREQHE2M		0.9 < V < 1.4 volts
56	CAL_THERM0P		2.2< V <2.8 volts
57	CAL_THERM0M		0< V < 0.50 volts
34	CAL_NDATA0_2P		0.9 < V < 1.4 volts
35	CAL_NDATA0_2M		0.9 < V < 1.4 volts
36	CAL_NDATA1_2P		0.9 < V < 1.4 volts
37	CAL_NDATA1_2M		0.9 < V < 1.4 volts
38	CAL_NTREQLE3P		0.9 < V < 1.4 volts
39	CAL_NTREQLE3M		0.9 < V < 1.4 volts
40	CAL_NTREQHE3P		0.9 < V < 1.4 volts
41	CAL_NTREQHE3M		0.9 < V < 1.4 volts
42	CAL_NDATA0_3P		0.9 < V < 1.4 volts
43	CAL_NDATA0_3M		0.9 < V < 1.4 volts
44	CAL_NDATA1_3P		0.9 < V < 1.4 volts
45	CAL_NDATA1_3M		0.9 < V < 1.4 volts
62	CAL_THERM1P		2.2 < V < 2.8 volts
63	CAL_THERM1M		1.5 < V < 2.0 volts